

# Effect of S and K Carriers on Yield, Quality and Nutrient Uptake by Mustard

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**Abstract:** A field experiment was conducted on medium black calcareous soil (Typic Ustochrepts) for studying the response of mustard (*Brassica juncea* L.) (Cv. Varuna) to different carriers of S (applied @30 kg S ha<sup>-1</sup>) and K (@75 kg K<sub>2</sub>O ha<sup>-1</sup>) along with FYM (@25t ha<sup>-1</sup>). The results revealed that significantly maximum grain yield (1102 kg ha<sup>-1</sup>) was noted along with N<sub>50</sub>P<sub>50</sub> FYM (1084 kg ha) and KCl (1073 kg ha<sup>-1</sup>) as source of K and were found at par with each other, but significantly superior to SSP and control treatment. Of course, gypsum and elemental S also found superior to control. The stover yield also increased significantly with NP, NPS and K additions. The availability of P, K and S in soil after harvest of the crop increased significantly with all the treatments, whereas organic carbon content increased significantly with FYM only. The S content in grain and stover increased significantly with different treatments. Significantly the highest total uptake of P, K and S was noticed with K<sub>2</sub>SO<sub>4</sub> only

**Keywords:** S Carriers, K Carriers, Mustard Yield, Nutrient Uptake, Nutrient Availability).

## I. INTRODUCTION

In recent years, sulphur deficiency has been aggravated in Indian soils due to continuous crop removal and use of high analysis S-free fertilizers. Sulphur plays a multiple role particularly in the nutrition of oilseed crops. Global reports of sulphur deficiency and consequent crop response are quite extensible (Tandon, 1989). Recently, the irrigated soils of Saurashtra were found to show a decline in K status and crop started responding to K application (Anon. 1992). In this context, the balance nutrition is highly essential to sustain the productivity of soil and crops (Gundalia et al., 1999 b; Mandal and Mamtaz, 2000). The present work was therefore under taken to compare the effect of different sources of S and K on yield and quality of mustard (*Brassica juncea* L.) grown on Typic Ustochrepts.

## II. MATERIALS AND METHODS

A field experiment was conducted for four years (1991-94) during rabi at Instructional Farm, College of Agriculture, GAU, Junagadh on medium black calcareous soils (Typic Ustochrepts) having clay loam texture, pH<sub>2.5</sub>, 8.0, EC<sub>2.5</sub> 0.61 dSm<sup>-1</sup>, lime 400 g kg<sup>-1</sup>, organic carbon 7.6g kg<sup>-1</sup> and available S (heat soluble) 12.5 mg kg<sup>-1</sup>. The available P and K values were 24.0 and 155 kg ha<sup>-1</sup>, respectively. Irrigation water contains 12.0 mg/l SO<sub>4</sub><sup>--</sup> ions. The nine treatments viz., T<sub>1</sub>-control, T<sub>2</sub>. FYM @25 t/ha every year, T<sub>3</sub>-NP (through urea and DAP) i.e., recommended dose, T<sub>4</sub>=T<sub>3</sub>+S<sub>50</sub>(through elemental S), T<sub>5</sub>=T<sub>3</sub>+S<sub>30</sub> (S through gypsum), T<sub>6</sub>=T<sub>3</sub>+S<sub>30</sub> (N and S through AS and P through KH<sub>2</sub>PO<sub>4</sub>), T<sub>7</sub>=T<sub>3</sub>+S<sub>30</sub> (S through SSP, remaining P through DAP and N through urea), T<sub>8</sub>=T<sub>3</sub>+S<sub>30</sub> (S through K<sub>2</sub>SO<sub>4</sub>) and T<sub>9</sub>= T<sub>3</sub>+K (K through KCl equal to K in K<sub>2</sub>SO<sub>4</sub>) were tried in RBD with four replications. The elemental S treatments were applied 21 days before sowing in order to hasten its oxidation. The crop was sown in rows 60 cm apart using 23 kg seed ha<sup>-1</sup> of variety Varuna. In all, crops received 8 to 9 irrigations and all the recommended agronomic practices were followed. The yield of grain and stover were recorded and soil and plant samples were collected from each net plot area at harvest for chemical analysis. Total N in plant materials was estimated by micro Kjeldahl method (Jackson, 1973). Diacid (HClO<sub>4</sub>: HNO<sub>3</sub> in 1:3 ratio) extract of plant samples was used for P (Vanadomolybdo phosphoric acid yellow colour method in HNO<sub>3</sub> system), K (Flame photometry) and S (colorimetric) determination. The organic carbon, available P (Olsen's

P), K (1N NH<sub>4</sub>OAc) and S (heat soluble) were determined from all the soil samples after harvest of the crop as per the standard method (Jackson 1973). Oil contents in seeds were determined by NMR device.

### III. RESULTS AND DISCUSSION

**Effect of yield:** The data present in Table 1 indicate that significantly the maximum grain yield (1102 kg ha<sup>-1</sup>) was noted with T<sub>8</sub> (S<sub>30</sub> through K<sub>2</sub>SO<sub>4</sub> along with N<sub>50</sub>P<sup>50</sup>) followed by T<sub>2</sub> (1084 kg ha<sup>-1</sup> with FYM @25 t ha<sup>-1</sup>) and T<sub>9</sub> (1073 kg ha<sup>-1</sup> with K as KCl) over control (T<sub>1</sub>) and even recommended dose of NP (T<sub>3</sub>). However, different S carriers were at par with each other and could not increase the grain yield over recommended dose of NP (T<sub>3</sub>). These results are in agreement with the work of Surendra Kumar (2001) who noted that gypsum, elemental sulphur and pyrite were equally effective. Perhaps this might be due to sufficient sulphate S in irrigation water (12.0 mg L<sup>-1</sup>) and in soil (12.5 ppm). Contrary, Patel et al. (1992) reported that elemental sulphur was superior over gypsum which produce 16.1 per cent higher seed yield. The increase in grain yield with K application might be attributed to medium K status in soil (155 kg ha<sup>-1</sup>) and its application provides a balance nutrition leading to increase in yield. Dubey and Shinde (1986) explained that the increase in pod and kernel yields with K application in groundnut was owing to increase in transformation of N from haulm to kernel by the effect of K. Patel et al. (1993) discussed the K dynamics in calcareous clay soils of Saurashtra and indicated that the soil having high free lime (>30%) and clay (>30%) are weak in K dynamics due to lower K reserve and concluded that in course of time, the crop may demand readily available K through fertilizers to sustain its productivity under such situation.

In case of stover yield, significantly the maximum stover yield (4332 kg ha<sup>-1</sup>) was recorded with treatment T<sub>6</sub> (N and S through AS and P through KH<sub>2</sub>PO<sub>4</sub>) followed by T<sub>5</sub> (S through gypsum) which were at par with each other and with T<sub>3</sub>, T<sub>4</sub>, T<sub>7</sub>, T<sub>8</sub> and T<sub>9</sub>, but significantly superior to control (T<sub>1</sub>) and even FYM (T<sub>2</sub>). These finding supported by the earlier work of Gundalia et al., (1999 b). Different sulphur sources remained at par and failed to produce significant effect on stover yield over normal recommended dose of NP (T<sub>3</sub>) might be due to its supply in sufficient amount from the soil and irrigation water.

**Effect on oil content:** The data (Table1) show that the lowest oil content (34.91%) in mustard grain was recorded with recommended dose of NP (T<sub>2</sub>). However, treatment T<sub>2</sub>, and T<sub>6</sub>, were found significantly superior to T<sub>3</sub>, T<sub>4</sub>, and T<sub>5</sub>, but were at par with absolute control (T<sub>1</sub>) owing to concentrate with lower yield.

Table 1 : Effect of different treatments on yield, oil content and nutrient status in soil at harvest

Treat-ments	Yield (kg ha <sup>-1</sup> )		Oil content (%)	Nutrient status in soil			
	Grain	Straw		O.C. (%)	P <sub>2</sub> O <sub>5</sub> (kg ha <sup>-1</sup> )	K <sub>2</sub> O (kg ha <sup>-1</sup> )	S (ppm)
T <sub>1</sub>	738	3223	35.39	0.72	29.0	153.3	14.48
T <sub>2</sub>	1084	4038	35.34	0.88	58.3	284.8	17.07
T <sub>3</sub>	945	4150	34.91	0.77	37.0	161.0	13.93
T <sub>4</sub>	992	4244	34.93	0.76	34.8	148.4	17.59
T <sub>5</sub>	994	4330	34.97	0.73	34.9	148.4	18.05
T <sub>6</sub>	1017	4332	35.34	0.75	31.4	151.9	17.81
T <sub>7</sub>	964	4052	35.14	0.75	33.3	146.3	17.71
T <sub>8</sub>	1102	4204	35.11	0.76	35.0	173.6	16.08
T <sub>9</sub>	1073	4244	35.13	0.75	33.2	174.3	15.43
S.Em.±	40.2	102.8	0.12	0.02	4.13	46.5	1.31
C.D. @5%	117.4	288.0	0.34	0.06	12.1	49.5	3.69
Initial soil status				0.75	24.0	155	12.5

cantly superior to T<sub>3</sub>, T<sub>4</sub> and T<sub>5</sub>, but were at par with absolute control (T<sub>1</sub>) owing to concentrate with lower yield.

**Effect on nutrient content and uptake:** Different treatments failed to produce significant effect on nutrient content in grain and stover, except K content in stover and S content in grain and stover, which were influenced significantly. The K content of straw was increased significantly with treatment T<sub>2</sub> and found at par with T<sub>8</sub>. Significantly the highest S content in grain and straw was found in treatment T<sub>8</sub> but it was at par with treatment T<sub>2</sub>, T<sub>4</sub>, T<sub>5</sub>, T<sub>6</sub>, T<sub>7</sub> and T<sub>9</sub> in case of grain and with T<sub>7</sub> in case of straw. The total uptake of all the nutrients were found significantly the lowest under T<sub>1</sub>. The highest uptake of N (86.54 kg ha<sup>-1</sup>) was found with T<sub>9</sub> and P (11.4kg ha<sup>-1</sup>) K (62.58 kg ha<sup>-1</sup>) and S (31.79 kg ha<sup>-1</sup>) with T<sub>9</sub> treatment because of recording higher content and grain and stover yields with these treatments. Similar results were also reported by Gundalia et al. (1999 a) in case of groundnut crop.

**Effect on nutrient status in soil:** in respect to soil status, only FYM (T<sub>2</sub>) registered significantly the higher content of organic carbon, P and K over control (T<sub>1</sub>) and rest of the other treatments. The maximum S status was registered under T<sub>5</sub> (S through gypsum), which was at par with other S carrier treatments, but significantly superior to normal recommended dose of NP (T<sub>3</sub>) The results are in agreement with the earlier work of Gundalia et al. (1999 a).

**Table 2. Effect of different treatment on content and uptake of nutrients by mustard.**

Treatments	Nutrient content (%)								Total uptake of nutrients (kg/ha)			
	N		P		K		S		N	P	K	S
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw				
T <sub>1</sub>	3.89	0.94	0.63	0.09	0.62	1.17	0.96	0.41	57.48	7.66	46.55	19.37
T <sub>2</sub>	3.98	0.96	0.67	0.10	0.58	1.33	0.79	0.45	80.82	11.38	62.33	27.04
T <sub>3</sub>	4.11	0.99	0.65	0.10	0.61	1.19	0.77	0.43	79.59	10.45	58.69	25.52
T <sub>4</sub>	4.07	1.03	0.65	0.10	0.60	1.17	0.80	0.44	81.90	10.36	59.56	26.35
T <sub>5</sub>	4.13	1.01	0.65	0.10	0.61	1.11	0.80	0.44	82.23	10.63	59.57	27.21
T <sub>6</sub>	4.09	0.96	0.66	0.10	0.59	1.08	0.81	0.45	81.17	10.92	55.42	27.76
T <sub>7</sub>	4.14	1.00	0.64	0.10	0.61	1.13	0.80	0.47	78.79	10.37	54.96	27.29
T <sub>8</sub>	4.07	0.99	0.65	0.10	0.58	1.29	0.83	0.52	84.76	11.40	62.28	31.19
T <sub>9</sub>	4.10	1.04	0.65	0.10	0.61	1.18	0.82	0.45	86.54	11.33	58.43	28.37
S.Em.±	0.06	0.03	0.01	0.01	0.01	0.04	0.01	0.02	2.13	0.31	2.11	0.99
C.D. @5%	NS	NS	NS	NS	NS	0.11	0.04	0.05	5.96	0.86	5.95	2.77

#### IV. CONCLUSION

From the above results it can be concluded that significantly maximum grain yield of mustard obtained with K<sub>2</sub>SO<sub>4</sub> along with recommended dose of NP fertilizer, FYM @ 25 ha<sup>-1</sup> and KCl.

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